PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

FIRST NOTICE INFORMING THE APPLICANT OF THE COMMUNICATION OF THE INTERNATIONAL APPLICATION (TO DESIGNATED OFFICES WHICH DO NOT APPLY THE 30 MONTH TIME LIMIT UNDER ARTICLE 22(1))

(PCT Rule 47.1(c))

To:

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ALLEMAGNE

Date of mailing *(day/month/year)* 10 February 2005 (10.02.2005)	
Applicant's or agent's file reference P803525/WO/1	**IMPORTANT NOTICE**

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/EP2004/007066	30 June 2004 (30.06.2004)	08 July 2003 (08.07.2003)

Applicant: DAIMLERCHRYSLER AG et al

1. **ATTENTION**: For any designated Office(s), for which the time limit under Article 22(1), as in force from 1 April 2002 (30 months from the priority date), **does apply**, please see Form PCT/IB/308(Second and Supplementary Notice) (to be issued promptly after the expiration of 28 months from the priority date).

2. Notice is hereby given that the following designated Office(s), for which the time limit under Article 22(1), as in force from 1 April 2002, **does not apply**, has/have requested that the communication of the international application, as provided for in Article 20, be effected under Rule 93*bis*.1. The International Bureau has effected that communication on the date indicated below:
20 January 2005 (20.01.2005)

   CH

   In accordance with Rule 47.1(c-*bis*)(i), those Offices will accept the present notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

3. The following designated Offices, for which the time limit under Article 22(1), as in force from 1 April 2002, **does not apply**, have not requested, as at the time of mailing of the present notice, that the communication of the international application be effected under Rule 93*bis*.1 :

   LU, SE, TZ, UG, ZM

   In accordance with Rule 47.1(c-*bis*)(ii), those Offices accept the present notice as conclusive evidence that the Contracting State for which that Office acts as a designated Office does not require the furnishing, under Article 22, by the applicant of a copy of the international application.

4. **TIME LIMITS for entry into the national phase**

   For the designated Office(s) listed above, and unless a demand for international preliminary examination has been filed before the expiration of **19 months** from the priority date (see Article 39(1)), the applicable time limit for entering the national phase will, **subject to what is said in the following paragraph,** be **20 MONTHS** from the priority date.

   In practice, **time limits other than the 20-month time limit** will continue to apply, for various periods of time, in respect of certain of the designated Offices listed above. For **regular updates on the applicable time limits** (20 or 21 months, or other time limit), Office by Office, refer to the *PCT Gazette*, the *PCT Newsletter* and the *PCT Applicant's Guide*, Volume II, National Chapters, all available from WIPO's Internet site, at http://www.wipo.int/pct/en/index.html.

   It is the applicant's **sole responsibility** to monitor all these time limits.

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer Agnes Wittmann-Regis
Facsimile No.+41 22 740 14 35	Facsimile No.+41 22 338 89 70

before the pressure then builds up and torque can thus be transmitted.

If a control device of the multi-step reduction gearbox and of the converter lock-up clutch detects a shifting-down request, for example owing to the activation of an accelerator pedal by a driver of a

vehicle, the multi-disk clutch which is to be connected is firstly filled in a filling phase. During this filling phase, the multi-disk clutch which is to be disconnected cannot yet be opened since otherwise there is the risk of an excessively large rise of the drive motor. As a result, the rotational speed of the drive motor does not begin to change until after the filling phase has ended. The start of the shifting-down process can therefore not be detected by the driver of the vehicle until after the filling phase has ended.

US 4 526 557 A describes a method for operating a drive train of a motor vehicle having a continuously variable automatic transmission. A converter with converter lock-up clutch is arranged between the drive motor and the automatic transmission. As soon as it is detected that a rapid adjustment in the direction of a shorter transmission ratio is necessary, the converter lock-up clutch is completely opened.

US 5 842 949 A describes a method for operating a drive train of a motor vehicle having an automatic transmission of a planetary design. A converter with converter lock-up clutch is arranged between the drive motor and the automatic transmission. In the case of a shifting-down request the converter lock-up clutch is completely opened. The opening speed is variable here.

In the article "Geregelte Wandlerkupplung für den neuen 7er von BMW [Controlled converter clutch for the new BMW 7 series]" by Ferit Kücükay and Christian Bock, published in ATZ Automobiltechnische Zeitschrift, Franck'sche Verlagshandlung Stuttgart, volume 96 (1994) No. 11, pages 690-697 a method is described for actuating a controlled converter lock-up clutch of a converter which is arranged between a drive motor and

an automatic transmission. A predefined slip is set at the converter lock-up clutch. In order to improve the shifting comfort the slip is increased during a shifting process.

The object of the invention is accordingly to propose a method for operating a drive train which permits spontaneous feedback of the drive train to values predefined by the driver of the vehicle and a comfortable shifting-down process. The object is achieved according to the invention by means of a method as claimed in claim 1.

The drive train has a power-shift automatic transmission, that is to say a transmission in which a transmission ratio of the transmission can be changed by means of actuator elements, in particular hydraulic clutches and brakes. When the transmission ratio changes, that is to say for example when there is a gearspeed change in the case of an automatic multi-step reduction gearbox, a drive connection between the drive motor and driven vehicle wheels is not interrupted. The change in the transmission ratio therefore occurs under load. The power-shift automatic transmission can therefore be embodied, for example, as an automatic multi step reduction gearbox of a planetary design or cylindrical gear design, an infinitely variable transmission or a double clutch transmission.

Shifting-down is understood to be shifting in the direction of a shorter transmission ratio of the automatic transmission, that is to say for example shifting from the fourth gearspeed into the third gearspeed of a multi-step reduction gearbox. In the case of an infinitely variable transmission, shifting-down is understood to mean adjustment of the transmission ratio in the direction of a shorter transmission ratio. In the case of shifting-down the rotational speed at the input to the automatic transmission, and thus the

rotational speed of the drive motor, are always larger after the shifting process than before the shifting process.

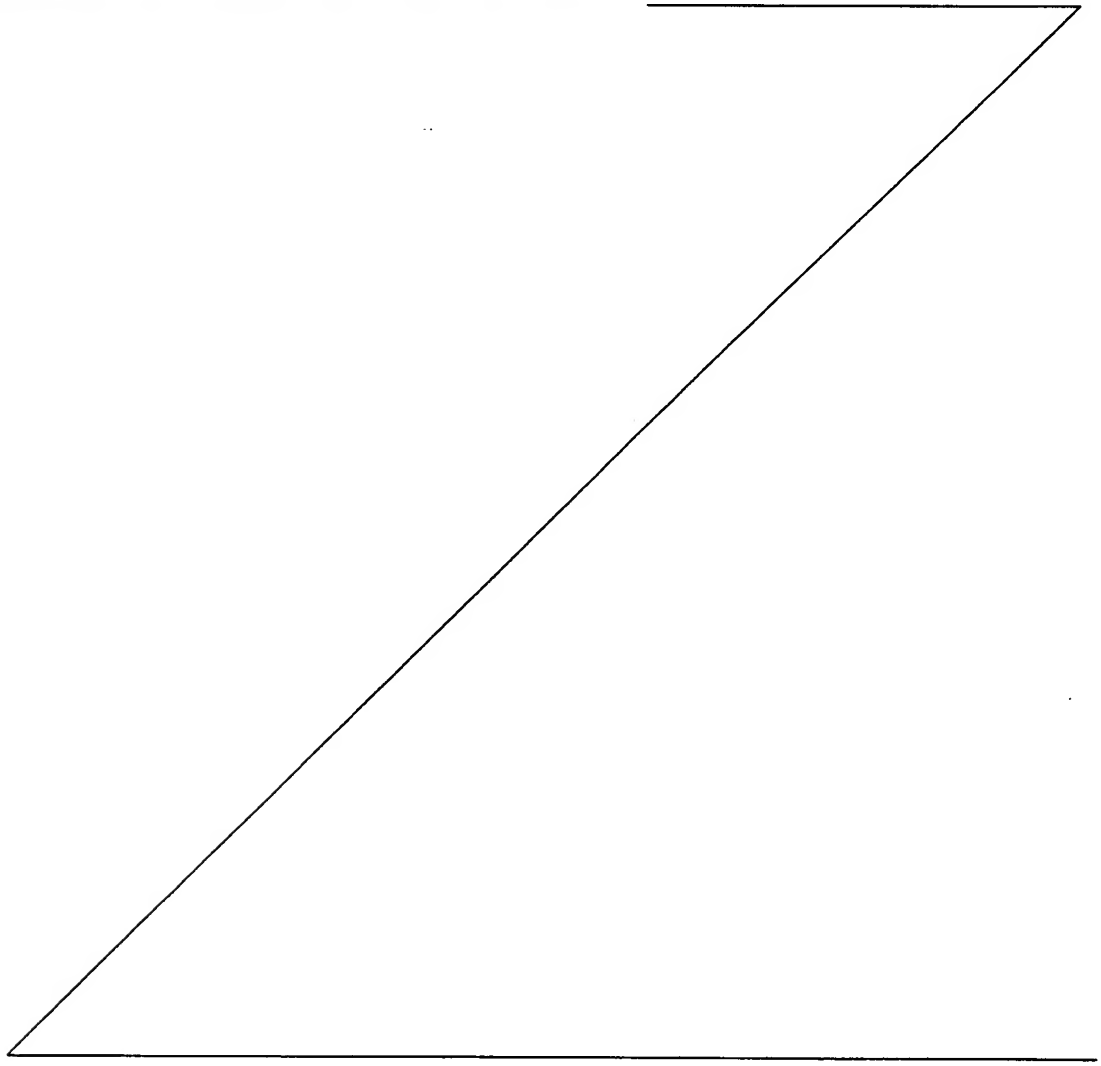
The clutch may be embodied, for example, as a converter lock-up clutch of a hydrodynamic converter or an automated starting clutch. The clutch can be activated by means of an electronic actuator element, for example an electric motor, or a hydraulic or pneumatic actuator element, for example a piston-cylinder unit, and thus opened and closed. A defined slip at the clutch, that is to say a defined differential speed between the clutch input and clutch output, can be set by means of the control device.

According to the invention, the control device increases slip at the clutch when a shifting-down request for the automatic transmission is detected. If the clutch was completely closed beforehand, a slip of greater than 0 is set starting from a slip of 0.

By increasing the slip at the clutch the rotational speed of the drive motor is adjusted in a monotonous and thus permanently increasing fashion to a target rotational speed after the shifting-down process has ended. In particular, the rotational speed of the drive motor can reach the target rotational speed just before the rotational speed at the input of the automatic transmission reaches the target rotational speed. The target rotational speed results from the speed of the motor vehicle after the shifting-down process has ended and the overall transmission ratio of the drive train which is made up, for example, of the transmission ratio of the automatic transmission and of a rear axle gearbox. The drive motor must reach this target

rotational speed after the shifting-down process has ended and the slip at the clutch has been eliminated. The monotonously increasing adjustment of the rotational speed to the target rotational speed can ensure a harmonic profile of the rotational speed of the drive motor during the shifting-down process. As a result the shifting-down process takes place in a particularly comfortable fashion.

The method according to the invention can be used advantageously in particular in conjunction with automatic transmissions in which

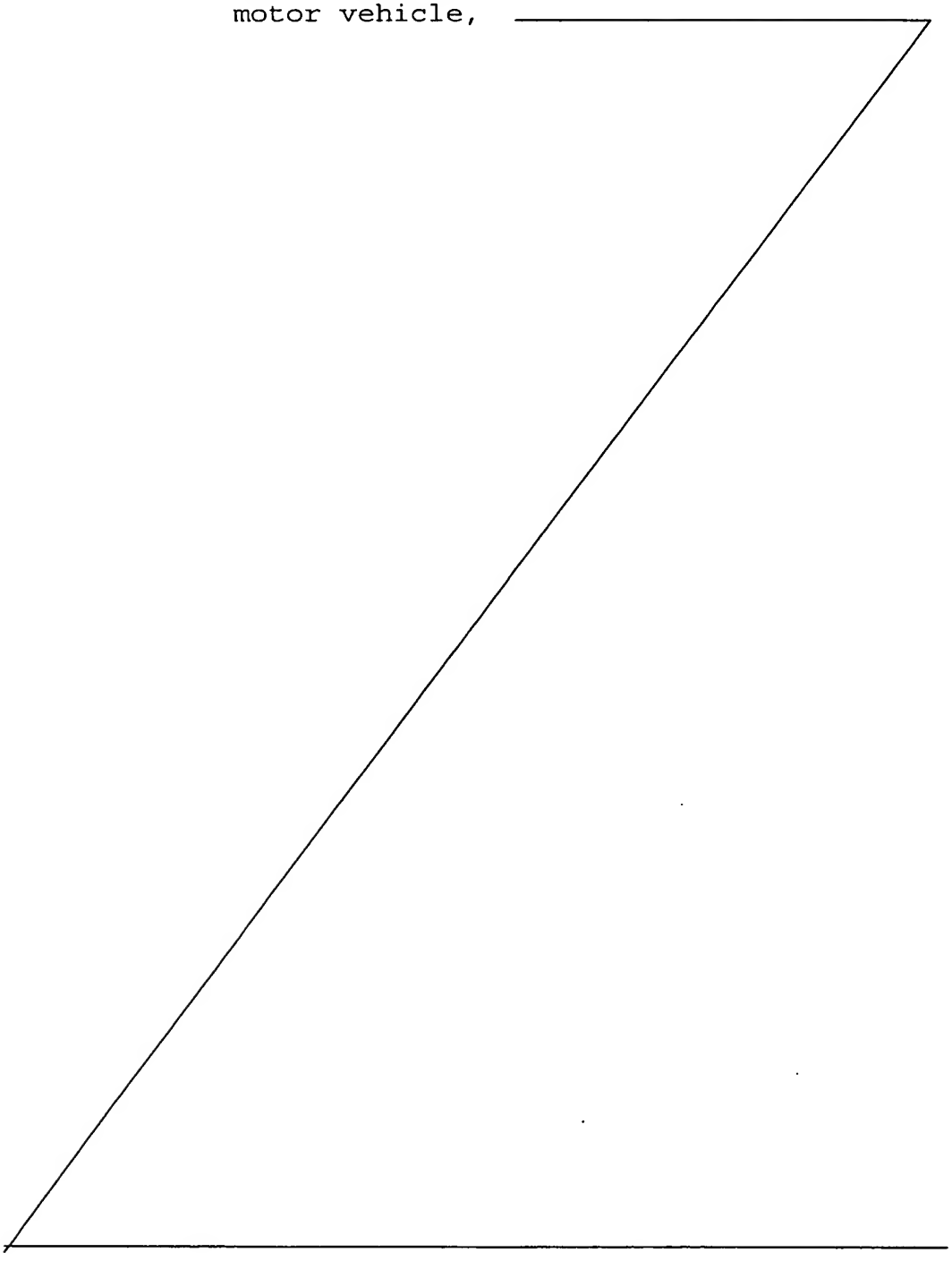


The increase in the slip and therefore also the reactions of the motor vehicle can thus be adapted to the driving style of the driver of the vehicle. For example, a higher slip can be set for a dynamic driving style, and a low slip, or even no slip at all, can be set for a steady driving style.

Further refinements of the invention emerge from the description and the drawing. Exemplary embodiments of the invention are illustrated in simplified form in the

drawing and explained in more detail in the following description. In the drawing:

figure 1 is a basic diagram of a drive train of a motor vehicle,



DaimlerChrysler AG

Patent Claims

1. A method for operating a drive train of a motor vehicle having
   - a drive motor (11),
   - a power-shift automatic transmission (14),
   - a clutch (15) which is arranged between the drive motor (11) and automatic transmission (14) and is activated by extraneous force, and
   - at least one control device (29) by means of which the automatic transmission (14) and the clutch (15) can be actuated,

with the control device (29) increasing a slip at the clutch (15) when a shifting-down request for the automatic transmission (14) is detected, characterized in that the control device (29) sets a defined slip in such a way that by increasing the slip at the clutch (15) a rotational speed of the drive motor (11) is adjusted in a continuously increasing fashion to a target rotational speed after the shifting-down process has ended.

2. The method as claimed in claim 1, characterized in that the slip at the clutch (15) is increased as a function of operational variables of the motor vehicle.

3. The method as claimed in claim 1 or 2, characterized in that
   - the drive train (10) has a power actuator (28) by means of which a driver of a vehicle can set a predefined power value for the drive motor (11), and

- the slip at the clutch (15) is increased as a function of a characteristic value which characterizes the predefined power value.

4. The method as claimed in claim 1, 2 or 3, characterized in that the slip at the clutch (15) is increased as a function of a characteristic value which characterizes the driving style of the driver of the vehicle.

5. The method as claimed in one of claims 1 to 4, characterized in that the control device (29) sets the defined slip in such a way that the rotational speed of the drive motor (11) reaches the target rotational speed before a rotational speed at the input of the automatic transmission (14).